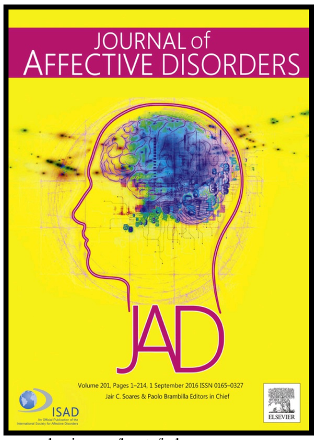
DOI:
10.1016/j.jad.2017.11.089

Document Version
Peer reviewed version

Citation for published version (APA):
Turton, R., Cardi, V., Treasure, J., & Hirsch, C. R. (2018). Modifying a negative interpretation bias for ambiguous social scenarios that depict the risk of rejection in women with anorexia nervosa. *Journal of Affective Disorders*, *227*, 705-712. https://doi.org/10.1016/j.jad.2017.11.089

Author's Accepted Manuscript



www.elsevier.com/locate/jad

Modifying a negative interpretation bias for ambiguous social scenarios that depict the risk of rejection in women with anorexia nervosa

Robert Turton, Valentina Cardi, Janet Treasure, Colette R. Hirsch

PII: S0165-0327(17)31691-9
DOI: https://doi.org/10.1016/j.jad.2017.11.089
Reference: JAD9403

To appear in: *Journal of Affective Disorders*

Received date: 11 August 2017
Revised date: 14 November 2017
Accepted date: 17 November 2017

Cite this article as: Robert Turton, Valentina Cardi, Janet Treasure and Colette R. Hirsch, Modifying a negative interpretation bias for ambiguous social scenarios that depict the risk of rejection in women with anorexia nervosa, *Journal of Affective Disorders,* https://doi.org/10.1016/j.jad.2017.11.089

Modifying a negative interpretation bias for ambiguous social scenarios that depict the risk of rejection in women with anorexia nervosa

Robert Turton*, Valentina Cardi, Janet Treasure[1], Colette R. Hirsch[1].

King's College London, Institute of Psychiatry, Psychology and Neuroscience, London, United Kingdom.

robert.turton@kcl.ac.uk;

valentina.cardi@kcl.ac.uk;

janet.treasure@kcl.ac.uk;

colette.hirsch@kcl.ac.uk.

***** Correspondence to: Robert Turton Section of Eating Disorders, King's College London, Institute of Psychiatry, Psychology & Neuroscience, 103 Denmark Hill, London, SE5 8AZ, United Kingdom. Email: robert.turton@kcl.ac.uk

[1] Joint last author.

Abstract

Background:

A heightened sensitivity to social rejection might contribute towards the interpersonal difficulties and symptoms that characterise Anorexia Nervosa (AN). This paper examines the effect of Cognitive Bias Modification for Interpretation biases (CBM-I) training on a negative interpretation bias for ambiguous social scenarios that involve the risk of rejection and eating behaviour.

Method:

Women with AN received a single session of CBM-I training to develop a more benign interpretational style or a control condition (which included 50:50 negative and benign resolutions). To measure participant's interpretation bias for social stimuli, a sentence completion task was used pre and post-training (a near-transfer outcome measure). A test meal was given after the training and salivary cortisol (stress) levels were measured as far-transfer outcome measures.

Results:

CBM-I training led to a significant reduction in a negative interpretation bias in both conditions. No effect on eating behaviour or stress was found, which may be expected as the training conditions did not significantly differ in interpretation bias change.

Limitations:

The control condition may have inadvertently reduced a negative interpretation bias as it involved listening to benign resolutions to ambiguous social scenarios for 50% of the trials.

Conclusions:

It is possible to modify a negative interpretation bias for social stimuli. To clarify the effect of CBM-I training on AN symptomatology, repeated, more intensive, and ecologically-valid training interventions may be required. This is because any change in eating behaviour may not be immediate, particularly in a population with a low body mass index and long-illness durations.

Keywords: Anorexia nervosa, interpretation bias, cognitive bias modification, eating behaviour.

1. Introduction

A priority for the eating disorders field is to increase understanding of the mechanisms that underpin these mental illnesses. Experimental psychopathology studies might help to address this matter by indicating whether a range of cognitive, behavioural, social and neural processes have a causal role in symptomatology (Jansen, 2016). This endeavour may ultimately lead to the development of more precise and personalised treatments, which has been highlighted as one of the top ten research agendas for eating disorders (see van Furth, van der Meer, & Cowan, 2016).

Theoretical models have suggested AN is associated with a range of interpersonal difficulties, including a heightened sensitivity towards social rejection. It is suggested that perceived/ actual social rejection might cause symptoms such as dietary restriction and weight-loss to develop as a maladaptive means of trying to improve self-worth and social acceptance, as well as to reduce negative affect. This is hypothesised to occur within the context of other risk and maintenance factors which may predispose individuals to be more attuned to social threats and vulnerable to eating disorder symptoms, such as an anxious and harm avoidant temperament, maladaptive emotion regulation skills, perfectionistic tendencies, and low core self-esteem that is unduly influenced by a person's weight (e.g., Fairburn, Cooper, & Shafran, 2003; Marzola, Fassino, Amianto, & Abbate-Daga, 2017). These factors may increase intra- and inter- personal sensitivity and exacerbate eating disorder symptoms by further isolating the individual (Arcelus et al., 2013; Atlas, 2004; Goss, & Gilbert, 2002; Reiger et al., 2010; Treasure & Schmidt, 2013; Treasure, & Cardi, 2017).

In support of interpersonal theories of AN, a recent study by Cardi et al. (submitted) found that early experiences of submissiveness in childhood and a fear of negative evaluation both significantly predict eating disorder symptoms in a sample of women with AN. Furthermore, experimental studies have confirmed that people with eating disorders have a heightened sensitivity to social rejection (Cardi, Di Matteo, Corfield, & Treasure, 2013; Cardi, Di Matteo, Gilbert, & Treasure, 2014). One cognitive mechanism that might underlie this sensitivity to rejection in AN could be a negative interpretation bias for ambiguous social stimuli that involve the risk of rejection. This bias been defined as a consistent tendency to resolve ambiguity in a negative manner (Hirsch, Meeten, Krahé, & Reeder, 2016). Indeed, Cardi et al. (2017) found that women with AN make more negative, and less benign, interpretations of ambiguous social scenarios that involve the risk for social rejection than healthy women. This negative bias was positively associated with a fear of weight gain and body dissatisfaction, as well as levels of depression and anxiety. Having established that women with AN differ from healthy controls, the aim of this study was to determine the causal role of this bias in maintaining eating disorder psychopathology. This is because casual influences could not be drawn from the findings of Cardi et al. (2017) due to the cross-sectional design of the study. Instead, approaches that modify this negative interpretation bias for social stimuli are needed to further elucidate its role in AN psychopathology and the clinical potential of targeting this bias (Treasure, Cardi, Leppanen, & Turton, 2015).

Cognitive Bias Modification for Interpretation (CBM-I) biases is a computerised training task that aims to ameliorate a negative interpretation bias (e.g., Grey & Mathews, 2000; Mathews & Mackintosh, 2000). It typically involves listening to ambiguous scenarios that are resolved in a benign manner. Cardi et al. (2015) piloted a novel cognitive training approach for adult women with AN receiving inpatient care by combining CBM-I with an attention bias modification training task to target cognitive biases relating to social stimuli. Promisingly, five sessions of cognitive training was associated with a reduction in participant's negative interpretation and attention biases for social stimuli (with medium effect sizes). There was a significant decrease in participant's levels of self-reported anxiety (small effect size). Furthermore, they had increased levels of self-compassion in response to a video clip that involved receiving negative feedback from a supervisor (medium effect size).

Given the encouraging finding that the effect of CBM-I transferred to a self-report measure of sensitivity to social rejection in AN (Cardi et al., 2015), an interesting next step could be to examine whether facilitating a more benign interpretational style for social stimuli also has an influence on eating behaviour and a biological marker of interpersonal stress levels (salivary cortisol). The present study tests these hypotheses by comparing a single session of benign interpretation training to a control condition on 'near-' (i.e., bias change) and, if differential bias change is achieved, then the impact on 'far-' transfer (i.e., eating behaviour, salivary cortisol) outcome measures.

As previous research has focused on inpatients, it would also be of interest to examine the effect of CBM-I training for women from the community as well. This may be an important research gap because women in the community could potentially experience increased feelings of isolation in comparison to women in inpatient services who have continuous support from their treatment team and other service-users (e.g., Treasure, Crane, McKnight, Buchanan, & Wolfe, 2011).

The aim of this study was to examine the impact of a single session of CBM-I training on interpretation biases for social stimuli that depict the risk of rejection and other AN related symptoms in both inpatient and community women. It was hypothesised that a 100% dose of CBM-I training (experimental condition) would produce a significantly greater change in participants' interpretation bias than a 50% dose (control condition). This was considered a 'near-transfer' outcome for CBM-I training. The study also included exploratory 'far-transfer' outcomes (i.e., effects on anxiety, salivary cortisol and test meal consumption).

2. Methods

2.1.1. Design

A within-subjects design was used, with participants completing a single session of an experimental and control version of CBM-I training. The different versions of the training were completed during two separate sessions, which were scheduled one week apart. To reduce order effects, an AB/BA crossover design was used with the random allocation of participants to either the experimental/ control condition first (e.g., Suresh, 2011).

2.1.2. *Participants*

A total of 55 women with AN were recruited. This included 26 adult women from inpatient eating disorder services (i.e., from the Bethlem Royal Hospital (*N* = 18), St Ann's Hospital (*N* = 6) and Vincent Square's Eating Disorders Service (*N* = 2)) and 29 adult women from the community. Participants were told that the study is, 'looking to learn more about how people with AN relate to social scenarios' and, 'computer brain training tasks in eating disorders'.

Eligibility criteria for the study included: a diagnosis of AN based upon DSM-5 criteria (American Psychiatric Association, 2013), an age range between 18 and 65, no current substance abuse, no neurological condition, no acute suicidality and no severe co-morbidity, such as psychosis. Participants were screened using the Structured Clinical Interview for the Diagnostic and Statistical Manual of Mental Disorders – fifth edition (American Psychiatric Association, 2013). An NHS Research Ethics Committee gave approval for the study (reference number, 14/LO/2166).

2.1.3. *Materials*

2.1.3.1. Questionnaires

Eating Disorders Examination Questionnaire (EDEQ)

The EDEQ (Fairburn & Beglin, 1994) measures participants eating psychopathology based upon their cognitions and behaviour over the previous 28 days. It has four subscales: weight concerns, shape concerns, dietary restraint, and eating concerns and gives an overall total score. The EDEQ has been found to be both a reliable (Luce & Crowther, 1999) and valid measure (Mond et al., 2004). The Cronbach's alpha for the weight concerns subscale = .8; shape concerns = .88; dietary restraint = .86; eating concerns = .8; total score = .95).

Depression Anxiety Stress Scales (DASS-21)

This 21-item questionnaire was developed by Lovibond and Lovibond (1995) and assesses participants' levels of depression, anxiety and stress during the past week. The measure has been reported to have good internal consistency and concurrent validity (Antony et al., 1998; Henry & Crawford, 2005). The Cronbach's alpha for the depression subscale = .91; anxiety = .88; stress = .87; total score = .94.

Adult Rejection Sensitivity-Questionnaire (ARS-Q)

The ARS-Q (Downey & Feldman, 1996) consists of nine scenarios that depict the risk for social rejection. For each scenario, participants are instructed to rate their levels of anxiety related to it and how likely they would expect to be rejected. The measure has been found to have satisfactory psychometric properties (Berenson et al., 2011). The Cronbach's alpha for the total score = .82.

Work and Social Adjustment Scale (WSAS)

This five-item self-report measure was developed by Marks (1986) and can be used to assess the level of impairment an identified problem causes to work and social functioning. The WSAS has been reported to be both a reliable (Zahra et al., 2014) and valid psychometric measure (Mundt, Marks, & Shear, 2002). The Cronbach's alpha for the total score = .86.

2.1.3.2. Computer tasks

Sentence completion task

This task was adapted from Cardi et al., (2015), Hayes et al., (2010) and Huppert et al., (2007). Following a brief practice of the task participants completed 10 stem-sentences, which describe hypothetical ambiguous social scenarios that involve the potential for social rejection (e.g., *"You message your close friend, it's been four hours and they haven't replied yet, you think that they are…"*). The scenarios are presented on a computer screen and over headphones with the instruction to write down as many completions to the scenarios as possible. For each scenario participants are also asked to place an asterix alongside the completion that they believe would **best** complete the scenario. Two research assistants (S.D. and L.D.) rated responses on the sentence completion task as being negative or benign completions. The raters were blind to the treatment allocation of the participants. There was high inter-rater reliability for their ratings (Cohen's kappa = .86). A third independent researcher (J.L.) resolved any discrepancies in their ratings.

CBM-I training

This cognitive training task was modified from Hirsch et al., (2009) and Cardi et al., (2015). Participants were instructed to listen over headphones to socially ambiguous scenarios that depict the risk of social rejection until the final word, which then resolves the scenario with either a negative, or benign completion (e.g., "*it is the night before your first day at a new job and you do not know many people within the company. When you arrive in the morning you think that you will be*… **welcomed**"). This was then followed by a comprehension question, which reinforced the completion to the ambiguous scenario (e.g., do think that your new colleagues will be pleased to meet you?), which has either a '*yes*' or '*no*' response (i.e., the letters 'Q' or 'P' on the keyboard respectively). A '*correct*' or '*incorrect*' feedback message and sound was given onscreen and over the headphones for 1000ms.

In the experimental condition, participants were presented with 90 ambiguous social scenarios that always had a benign completion and a comprehension question that reinforced this. Participants were also presented during the task with 10 test ambiguous social scenarios that did not have any resolution but were followed by a 'yes' or 'no' question. These 'catch trials' were used to assess participant's interpretational style during the course of the training. In the control condition, a similar procedure was used with the only difference being that half of the 90 ambiguous social scenarios had a negative completion with the other half having a benign resolution (45 of the trials).

2.1.3.3. Visual Analogue Scales (VASs)

A self-report questionnaire using VASs (i.e., 10cm long) was used to determine participant's state levels of hunger (at baseline only; anchored by "not hungry at all" and "extremely hungry"), anxiety (anchored by "not anxious at all" and "extremely anxious"), and mood (anchored by "extremely low" and "extremely high").

2.1.3.4. Salivary cortisol levels

Saliva samples were collected using Salivettes'® (Sarstedt). These were analysed for their cortisol concentration by the Biochemistry department at King's College London. This was to provide an objective measure of participants stress levels following the CBM-I training. Community women were all scheduled to take part at 11am and inpatients were scheduled to take part in the study at 3.30pm.

2.1.3.5. Filler task

The speed of comprehension test

Following the training participants completed the speed of comprehension test (Baddeley, Emslie & Nimmo-Smith, 1992) as a filler task to lower the chance of group differences in mood influencing the test meal. The use of the filler task is in line with the protocols of previous CBM-I research (e.g., Hayes et al., 2010).

2.1.3.6. Eating behaviour

Test meal: the smoothie challenge task

A choice of three smoothie drinks were presented to participants as purchased in the bottle (250ml each). The smoothie drink flavours were: '*kiwi, apples and lime*', '*mangoes and passion fruits*' and '*strawberries and bananas'*. Participants were asked to choose one of the smoothies and were then asked to drink as much as they felt able and comfortable to during a five-minute period. The amount of smoothie consumed was measured.

2.1.4. *Procedure*

Participants completed a set of baseline questionnaires prior to taking part in the study using www.surveymonkey.net. This included a demographics questionnaire, the EDEQ, DASS-21, ARS-Q and WSAS. Participants were informed that they should consume something to eat 1.5/2hours prior to the study and to then not eat anything until the time of the study, though drinking water was fine before both sessions.

The testing took place at the inpatient sites or at King's College London. At the beginning of the first session participant's completed the sentence completion task on a laptop with the task programmed on E-Prime, version two. This was followed by a baseline set of VASs and a saliva sample (time point one: T1) and either the experimental/ control version of the CBM-I training on the laptop depending on which condition they were randomly allocated to for the first session. After the training, participants completed the VASs and gave a saliva sample again (time point two: T2) and the sentence completion task post-training to assess participants interpretational style. A different set of ambiguous stem sentences were presented post-training. The filler task was then given to participants, followed by the smoothie challenge task. For inpatients the smoothie was in place of their afternoon snack on the ward. Participants then completed the final set of VASs and gave a saliva sample (time point three: T3). Please see **supplementary item 1** for additional information on the study's design.

In the second session, a similar procedure to the first session was completed with participants doing a different version of the CBM-I training, depending on what they did in the first session (i.e., either the experimental/ control condition). A different set of ambiguous scenarios were also used in the sentence completion task in the second session. Please see **figure 1.** for an overview of the studies procedure.

2.1.5. *Statistical analyses*

A mixed effects linear model (bootstrapped at 500 repetitions) using Stata version 14® (StataCorp, 2015) and the mepoisson command was used to analyse the frequency of negative and benign 'best' responses on the sentence completion task (i.e., the ending that participants thought would best resolve the ambiguous scenario). The predictors included in the model were patient group (i.e., inpatient or community women with AN), training condition (i.e., experimental or control CBM-I), time point (i.e., pre or post CBM-I training) and interpretation valence (i.e., negative or benign).

A series of mixed effects linear models (bootstrapped at 1000 repetitions) were performed to investigate the CBM-I training task data, VAS responses, stress levels as measured salivary cortisol levels and smoothie challenge task data. As the study used a repeated measures design, effect sizes were calculated as Standardised Mean Change (SMC) scores (e.g., Morris & DeShon, 2002) for the primary outcome measures (i.e., the catch trials, sentence completion task and test meal). SMC effect sizes were calculated for each training condition and are understood as small (=> .2), moderate (=> .5) and large (=> .8).

3. Results

3.1. *Participant characteristics*

Please see **table 1.** for an overview of the demographic and clinical characteristics of the women with AN. Also, almost half (*N* = 24) had comorbidity with anxiety disorder or depression and (*N* = 26) were taking antidepressant medications at the time of the study. The community women with AN were significantly older than the inpatients with AN, and had longer illness durations and greater levels of eating disorder psychopathology (i.e., on the EDEQ restraint, eating concern and total scales). Participants' baseline levels of hunger, anxiety and mood did not significantly differ between the experimental and control conditions (all $p > .05$).

3.2. CBM-I training task data

3.2.1. Accuracy on the comprehension trials

Accuracy levels on the comprehension trials were analysed using a 2x2 mixed effects linear model (i.e., patient group x training condition) which showed a significant main effect of patient group ($X^2(1) = 11.63$, $p = .0006$) and training condition ($X^2(1) = 4.22$, $p = .04$).

Pairwise comparisons showed that the inpatient women with AN were significantly more accurate on the comprehension trials ($M = 82.46$, $SD = 8.68$) than the community women with AN ($M = 76.21$, $SD = 16.06$; $Z = 3.41$, $p = .001$). Also, participants were significantly more accurate in the experimental (M = 81.37, SD = 13.88) versus control condition (M = 77.05, SD = 12.62) on the comprehension trials (Z = 2.05, p = .04). There was no significant interaction between patient group and training condition ($X^2(1) = .04$, p = .837)[2].

3.2.2. Catch trial responses

A 2x2 mixed effects linear model (i.e., patient group x training condition) did not find a significant main effect of patient group ($X^2(1)$ = .55, p = .46) or training condition ($X^2(1)$ = .79, p = .374) or interaction between these predictors ($X^2(1)$ = .19, p = .66) on the number of benign responses made on the catch trials (experimental condition M = 6.13, SD = 2.04, control condition M = 5.83, SD = 1.91; SMC effect size: negligible to small = .14).

3.3. 'Near-transfer' outcome measures

3.3.1. Sentence completion task ('Best' interpretations)

---

[2] A total of 28 participants (N = 15 inpatients and N = 13 community women) had accuracy scores over 90% on the comprehension trials in both the experimental and control conditions. For this group of participants, post-training there were trends for participants to make less negative (Z = -1.94, p = .052) and more benign interpretations (Z = 1.73, p = .084) than pre training in both conditions. There were no significant differences between conditions in the catch trial responses or test meal consumption (p > .05).

A 2x2x2x2 mixed effects linear model (i.e., patient group x training condition x time point x valence) showed there was a significant interaction between patient group and valence for the frequency of 'best' interpretations ($X^2(1) = 32.36$, $p < .001$). Subsequent pairwise comparisons showed that the community women with AN made significantly more negative 'best' interpretations ($M = 5.76$, $SD = 2.66$) than the inpatient women with AN ($M = 4.15$, $SD = 2.54$; $Z = 4.14$, $p < .0001$). They also made less benign 'best' interpretations ($M = 4.15$, $SD = 2.62$) than the inpatient women with AN ($M = 5.66$, $SD = 2.56$; $Z = -4.12$, $p < .0001$).

There were no significant main effects or interactions involving training condition (all $p > .05$) (please see **supplementary item 2.** for the individual test results). This suggests that the experimental and control conditions did not significantly differ in terms of interpretation bias change. Instead, there was evidence that both conditions reduced interpretation bias. This was indicated by a significant interaction between time point and valence ($X^2(1) = 19.76$, $p < .001$). In both conditions participants made significantly less negative 'best' interpretations post-training ($M = 4.4$, $SD = 2.66$) than pre ($M = 5.6$, $SD = 2.65$; $Z = -2.89$, $p = .004$). They also made more benign 'best' interpretations post-training ($M = 5.4$, $SD = 2.64$) than pre training ($M = 4.33$, $SD = 2.65$; $Z = 3.02$, $p = .003$).

To help aid the development of future studies effect sizes were calculated for the change in interpretation bias. A moderate to large effect size was found in the experimental condition for the reduction in a negative interpretation bias (SMC effect size = -.66) versus a small to moderate effect size in the control condition (SMC effect size = -.42). Please see **table 2.** for the means and effect sizes per training condition and patient group.

3.3.2. Visual analogue scales

3.3.2.1. Anxiety ratings

A 2x2x2 mixed effects linear model (i.e., patient group x training condition x time point) showed that there was a significant main effect of time point on participants anxiety ratings ($X^2(2) = 21.01$, $p < .001$). Pairwise comparisons showed that in both conditions there was no significant difference in anxiety ratings between pre (T1) ($M = 4.63$, $SD = 2.71$) and post (T2) training ($M = 4.82$, $SD = 2.51$; $Z = .77$, $p = .441$). Anxiety ratings post smoothie challenge task (T3) ($M = 5.72$, $SD = 2.78$) were significantly greater than at T2 ($Z = 3.79$, $p < .0001$) and T1 ($Z = 4.25$, $p < .0001$). There was no significant main effect of patient group ($X^2(1) = 3.69$, $p = .0549$), training condition ($X^2(1) = .44$, $p = .508$), or interactions between these predictors (all $p > .05$).

3.3.2.2. Mood ratings

A 2x2x2 mixed effects linear model (i.e., patient group x training condition x time point) showed that there was a significant main effect of time point on participants mood ratings ($X^2(2) = 11.52$, $p = .0032$). Pairwise comparisons showed that in both conditions mood ratings were significantly lower (i.e., participants felt more down) post training (T2) ($M = 3.76$, $SD = 2.02$) than pre training (T1) ($M = 4.23$, $SD = 1.82$; $Z = -2.83$, $p = .005$). Mood ratings post smoothie challenge task (T3) ($M = 3.65$, $SD = 2.22$) were significantly lower than T1 ($Z = -3.13$, $p = .002$). There was no significant difference between T3 and T2 ($Z = -.66$, $p = .51$). There was no significant main effect of patient group ($X^2(1) = .07$, $p = .7933$), training condition ($X^2(1) = 1.14$, $p = .287$), or interactions between these predictors (all $p > .05$).

3.4. ‘Far-transfer’ outcome measures

There were no significant differences between training conditions on the interpretation bias near transfer task. Given this, one would not anticipate any significant differences on the far transfer measures since the key mechanism was not differentially changed. The results below are reported for completeness.

3.4.1. Test meal: Smoothie consumption

A 2x2 mixed effects linear model (i.e., patient group x training condition) showed that there were no significant mains effect of patient group ($X^2(1) = 1.6$, $p = .2057$) or training condition ($X^2(1) = .02$, $p = .8814$) or interaction between these predictors ($X^2(1) = .3$, $p = .58$) on smoothie consumption (measured in milliliters) (experimental condition: $M = 68.65$, $SD = 90.65$, control condition: $M = 67.47$, $SD = 87.17$; SMC effect size: negligible = .02).

3.4.2. Salivary cortisol levels

A 2x2x3 mixed effects linear model (i.e., patient group x training condition x time point) showed that there was a significant main effect of patient group ($X^2(1) = 152.65$, $p < .0001$). Post-hoc pairwise comparisons showed that the community women had higher levels of salivary cortisol ($M = 7.58$, $SD = 4.76$) than the inpatient women with AN ($M = 5.13$, $SD = 2.26$; $Z = 12.36$, $p < .0001$). This finding is to be expected as the community women with AN were tested in the morning when cortisol levels are naturally higher. There was no significant main effect of training condition ($X^2(1) = 1.46$, $p = .23$), time point ($X^2(2) = 2.34$, $p = .31$), or interactions between these predictors (all $p > .05$). Please see **supplementary item 3.** for the means per training condition.

4. Discussion

This study hypothesised that a 100% dose of CBM-I training (experimental condition) would produce a significantly greater change in participants' interpretation bias for ambiguous social stimuli that depict the risk of rejection in comparison to a 50% dose (control condition). The study also included exploratory hypotheses (i.e., there would be effects of the training on anxiety, salivary cortisol and test meal consumption). The study found that participants made significantly less negative and more benign 'best' (endorsed) interpretations after both training conditions. Given that the experimental and control conditions did not significantly differ in terms of the reduction in interpretation bias for social stimuli, one would not expect differential effects on far transfer to 'symptoms'. In keeping with this, there were no significant differential effects on anxiety, eating behaviour or stress (salivary cortisol levels) after a single session of training.

The findings of this study suggest that it may be possible to modify a negative interpretation bias for social stimuli in AN using both a 100% (experimental condition) and 50% dose (control condition) of CBM-I training. An exploratory analysis of effect sizes indicated that there was some evidence for a greater reduction in negative interpretation bias in the experimental versus control condition (experimental condition SMC effect size = -.66, versus control condition SMC effect size = -.42). A possible explanation for the reduction in a negative interpretation bias for social stimuli in both training conditions might be that the control condition also included benign resolutions for half of the CBM-I trials (50%). This lower dose of the training in the "control" condition may have been sufficient to modify participant's interpretational style. The effect of both training conditions is also potentially evidenced by participants giving benign responses to more than half of the catch trials in both training conditions (experimental $M = 6.13$, control $M = 5.83$).

Anxiety levels did not decrease from pre to immediately post CBM-I training in either condition, in keeping with other single session CBM-I research (e.g. Hirsch et al 2009; Hayes at al 2010) where the intention is to modify interpretations temporarily and then determine its impact of subsequent stress tests. Multi-session CBM research often examines longer term changes in anxiety and indeed Cardi et al. (2015) found that anxiety levels reduced following six sessions of experimental CBM-I. Hence, multiple sessions of CBM-I training is needed to reduce anxiety in individuals with AN. Unexpectedly, the present study found that participant's mood was lower (i.e., they felt more down) following both CBM-I training conditions, perhaps due to participant fatigue. This effect was not found by Cardi et al. (2015), which used shorter training sessions (i.e., 18 CBM-I training trials per session).

Another noteworthy finding from this study was that overall the community women with AN had a significantly greater negative interpretation bias for social stimuli than the inpatient women with AN. This could be due to their longer illness durations and higher levels of eating disorder psychopathology. However, this finding could also be due to sampling bias. For example, people in the community with heightened social sensitivity/ isolation being particularly interested in taking part in the study due to its focus on social difficulties. Furthermore, the community women with AN were significantly older than the inpatient with AN, perhaps reflecting the increased rates of inpatient hospital admissions for young adults with AN in England (Holland, Hall, Yeates, & Goldacre, 2016). Therefore, it is unknown whether a younger population in the community with a more recent illness onset would also have an increased negative interpretation bias for social stimuli in comparison to inpatient women with matched clinical characteristics.

A limitation of this study is that inpatient and community participants were tested at different times for pragmatic reasons. Also, the test meal procedure did not involve social ambiguity, meaning that it may be regarded as quite a considerable far-transfer outcome measure for a single session of CBM-I training. Particularly given that the population recruited in the present study had a low body mass index (M = 15.4) and long-illness durations (M = 10.9 years), meaning that a single session CBM-I training may not produce an immediate effect on core symptoms such as eating behaviour. A question for future endeavours could be to clarify the boundary of any training effect, by using far- transfer outcome measures that are more aligned with the primary aim of the training (reducing sensitivity to social rejection in situations that are open to multiple interpretations). For example, the Cyberball task is a novel paradigm that can be used to test people's reactions to either social inclusion or rejection (participants are either included or excluded from a computerised ball-throwing game) (Williams, Cheung & Choi, 2000). This task may be more closely related to the primary aim of CBM-I training (to reduce rejection sensitivity) than the test meal procedure used in the present study.

4.1. Future research directions

In order to produce larger effects on interpretation bias and other AN related symptoms multiple training sessions as used in the case series by Cardi et al. (2015), are probably needed. Particularly, as people with AN show decreased learning from feedback in both the acute state and after weight restoration (Foerde & Steinglass, 2017). This may explain why participant's accuracy scores on the comprehension trials were lower than those previously reported in other populations (e.g., Hayes et al. (2010) reported that people with generalised anxiety disorder were accurate on 92.5% of the comprehension trials in the active condition). To test this hypothesis, it may have been beneficial to include a separate non-eating disorder group who have equally high levels of sensitivity to social rejection to examine whether they are more accurate on the comprehension trials than people with eating disorders.

Krahé, Mathews, Whyte, & Hirsch (2016) have recently developed a novel control condition for CBM-I research, that may be considered more 'neutral' than the one used in the present study. This involves CBM-I trials keeping their neutrality entirely, instead of being given a negative or benign meaning (e.g., "*You add a new colleague at work on a social networking website but it's been several hours and they haven't approved your request yet. Thinking about it that evening, you wonder whether they will accept your friend request*"). This approach has been shown to be effective in a multi-session training study for people with affective disorders (i.e., the control differs from active CBM in terms of change in bias and outcome of emotion) (Hirsch et al., submitted). Therefore, it may be beneficial for future research to also use this control condition in eating disorders.

The present study focused on a negative interpretation bias in response to social situations that involve the risk of rejection. In future research it might be of benefit to further examine the factors that either increase vulnerability/ protect from having a negative interpretation bias for social stimuli and increased sensitivity to social rejection. In emotional disorders (Hirsch, Clark, & Mathews, 2006; also see Everaert, Koster, & Derakshan, 2012 specific to depression) it has been hypothesised that a range of information processing biases relating to interpretation, attention, mental imagery, cognitive control and memory, may interplay with one another rather than acting in isolation to maintain distress. Therefore, future research may seek to examine whether several cognitive biases combine together and increase vulnerability for sensitivity to social rejection and eating disorder symptoms. Furthermore, it may also be interesting to examine whether there is an association between a negative interpretation bias for social stimuli with other clinical characteristics and personality traits. This research could also include a group of people that have recovered from AN to investigate whether a negative interpretation bias for social stimuli remains once people are no longer symptomatic. Furthermore, it would be interesting to know whether the extent to which those in recovery still have a negative interpretation bias for social stimuli predicts later relapse.

A recent study by De Paoli, Fuller-Tyszkiewicz, Halliwell, Puccio and Krug (2017) found that appearance-based rejection sensitivity mediates the relationship between insecure attachment styles and disordered eating in an eating disorder sample (AN, bulimia nervosa and binge eating disorder). Given that previous research has also suggested an association between negative interpretation bias and body dissatisfaction (Cardi et al., 2017), it would be of interest to adapt CBM-I training materials to also target appearance-based rejection sensitivity in future research.

4.2. Implications

CBM-I training primarily targets 'automatic' thought processes, whereas traditional talking therapies are more focused on 'reflective' processes. Given this, future work could test whether using CBM-I alongside therapeutic interventions such as cognitive behavioural or interpersonal psychotherapy has additive effects. For instance, with the support of a therapist goal-setting approaches may help patients to translate their learning from CBM-I into 'real life' situations. To make the CBM-I training more engaging, one possibility is to have shorter training sessions. Another approach could be to also use alternate interpretation training paradigms such as homograph training, which involves repeatedly pairing homographs (e.g., row) with non-threat (e.g., a boat) as opposed to threat related (e.g., argument with a friend) words (see Hirsch et al., 2016 for an overview). Finally, as this study suggested that community women with AN might have an increased negative interpretation bias of social stimuli than inpatients, therapeutic approaches that may reduce sensitivity to social rejection, such as compassion focused treatments (Goss, & Allan, 2014) and CBM-I may be particularly warranted for this group of people.

4.3. Conclusion

Following CBM-I women with AN made significantly less negative ‘best’ interpretations for ambiguous social stimuli that depict the risk of rejection after one session of both training conditions. There were negligible effects on other AN related symptoms (anxiety and eating behaviour), which may be expected given that the training conditions did not significantly differ in interpretation bias change. In future research multiple sessions of training and far-transfer outcome measures that are closer to the primary aim of the training (reducing sensitivity to social rejection in ambiguous situations) may be used to establish the boundary of the CBM-I training effect in AN and the clinical potential of modifying this bias.

Acknowledgements

Thank you to all of the participants for their help with this study. The authors would also like to thank Lavinia Thelan for her assistance with testing; Sophie Duggan, Lindsey Henderson and Jenni Leppanen for their help with coding the sentence completion task data.

Role of funding source

Robert Turton receives funding from the Medical Research Council (MRC) and the Psychiatry Research Trust (PRT) (Grant PCPTAAR). Dr. Colette Hirsch, Professor Janet Treasure OBE and Dr. Valentina Cardi, receive salary support from the National Institute for Health Research (NIHR), Mental Health Biomedical Research Centre at South London and Maudsley NHS Foundation Trust and King's College London. The views expressed in this article are those of the author(s) and not necessarily those of Kings College London, CAPES, UFRJ, the MRC, PRT, the NIHR or the Department of Health. The funders had no role in the design of this study, the analysis of findings or the preparation of this manuscript.

Conflict of interest

The authors report no conflict of interests.

Contribution statement

Robert Turton, Professor Janet Treasure, Dr Colette R. Hirsch, and Dr Valentina Cardi designed this study and contributed to the intellectual content of it. The NHS ethics application, recruitment, stimulus creation, testing, data analysis and manuscript preparation was completed by Robert Turton. All of the authors contributed to and approved the final manuscript.

Acknowledgements

Thank you to all of the participants for their help with this study. The authors would also like to thank Lavinia Thelan for her assistance with testing; Sophie Duggan, Lindsey Henderson and Jenni Leppanen for their help with coding the sentence completion task data.

Role of funding source

Robert Turton receives funding from the Medical Research Council (MRC) and the Psychiatry Research Trust (PRT) (Grant PCPTAAR). Dr. Colette Hirsch, Professor Janet Treasure OBE and Dr. Valentina Cardi, receive salary support from the National Institute for Health Research (NIHR), Mental Health Biomedical Research Centre at South London and Maudsley NHS Foundation Trust and King's College London. The views expressed in this article are those of the author(s) and not necessarily those of Kings College London, CAPES, UFRJ, the MRC, PRT, the NIHR or the Department of Health. The funders had no role in the design of this study, the analysis of findings or the preparation of this manuscript.

References

American Psychiatric Association (2013). Diagnostic and statistical manual of mental disorders. 5th ed. Arlington, VA: American Psychiatric Publishing.

Antony, M., Bieling, P., Cox, B., Enns, M., & Swinson, R. (1998). Psychometric properties of the 42-item and 21-item versions of the Depression Anxiety Stress Scales in clinical groups and a community sample, *Psychological Assessment*, 10 (2), 176-181. doi: 10.1037/1040-3590.10.2.176.

Arcelus, J., Haslam, M., Farrow, C., & Meyer, C. (2013). The role of interpersonal functioning in the maintenance of eating disorder psychopathology: a systematic review and testable model. *Clinical Psychology Review*, 33, 156-67. doi: 10.1016/j.cpr.2012.10.009

Atlas, J. (2004). Interpersonal sensitivity, eating disorder symptoms, and eating/ thinness expectations, *Current Psychology*, 22: 368. doi 10.1007/s12144-004-1041-y.

Baddeley, A., Emslie, H., & Nimmo-Smith, I. (1992). The speed of comprehension test: version A. In Speed and capacity of language processing test. Thames Valley Test Company: Suffolk.

Berenson, K., Downey, G., Rafaeli, E., Coifman, K., & Leventhal, N. (2011). The rejection-rage contingency in borderline personality disorder, *Journal of Abnormal Psychology*, 120 (3), 681-90. doi: 10.1037/a0023335.

Cardi, V., & Di Matteo, R., Corfield, F., & Treasure, J. (2013). Social reward and rejection sensitivity in eating disorders: An investigation of attentional bias and early experiences. *The World Journal of Biological Psychiatry*, 14, 622-33. doi: 10.3109/15622975.2012.665479

Cardi, V., Di Matteo, R., Gilbert, P., & Treasure, J. (2014). Rank perception and self-evaluation in eating disorders. *International Journal of Eating Disorders*, 47, 543-52. doi: 10.1002/eat.22261

Cardi, V., Esposito, M., Bird, G., Rhind, C., Yiend, J., Schifano, S., Hirsch, C.R., & Treasure, C. (2015). A preliminary investigation of a novel training to target cognitive biases towards negative social stimuli in Anorexia Nervosa. *Journal of Affective Disorders*, 1, 188-93. doi: 10.1016/j.jad.2015.08.019.

Cardi, V., Mallorquí-Bagué, N., Albano, G., Monteleone, A., Fernández-Aranda, F., & Treasure, J. (submitted). A mixed-method investigation of social difficulties as risk and maintaining factors in anorexia nervosa, *European Eating Disorders Review*.

Cardi, V., Turton, R., Schifano, S., Leppanen, J., Hirsch, C., & Treasure, J. (2017). Biased interpretation of ambiguous social scenarios in anorexia nervosa, *European Eating Disorders Review*, 25 (1), 60-64. doi: 10.1002/erv.2493.

De Paoli, T., Fuller-Tyszkiewicz, M., Halliwell, E., Puccio, F., & Krug, I. (2017). Social Rank and Rejection Sensitivity as Mediators of the Relationship between Insecure Attachment and Disordered Eating, *European Eating Disorders Review*, doi: 10.1002/erv.2537.

Downey, G., & Feldman, S. (1996). Implications of rejection sensitivity for intimate relationships, *Journal of Personality & Social Psychology*, 70 (6), 1327-43.

Everaert, J., Koster, E. H., & Derakshan, N. (2012). The combined cognitive bias hypothesis in depression, *Clinical psychology review*, *32*(5), 413-424.

Fairburn, C., & Beglin, S. (1994). Assessment of eating disorder psychopathology: interview or self-report questionnaire? *International Journal of Eating Disorders*, 16, 363-370.doi: 10.1002/1098-108X(199412)16:4<363::AID-EAT2260160405>3.0.CO;2-#.

Fairburn, C. G., Cooper, Z., & Shafran, R. (2003). Cognitive behaviour therapy for eating disorders: A “transdiagnostic” theory and treatment, *Behaviour research & therapy*, *41*(5), 509-528.

van Furth, E., van der Meer, A., & Cowan, K. (2016). Top 10 research priorities for eating disorders, Lancet Psychiatry, 3 (8), 706-7. doi: 10.1016/S2215-0366(16)30147-X.

Foerde, K., & Steinglass, J. E. (2017). Decreased feedback learning in anorexia nervosa persists after weight restoration, *International Journal of Eating Disorders*, *50*(4), 415-423. doi: 10.1002/eat.22709.

Goss, K., P., & Gilbert, P. (2002). Eating disorders, shame and pride: A cognitive-behavioural functional analysis. In P. Gilber, & J. Miles (Eds), *Body shame: Conceptualisation, research & treatment* (pp.219-255). Hove, UK:Brunner-Routledge.

Grey, S., & Mathews, A. (2000). Effects of training on interpretation of emotional ambiguity, *The Quarterly Journal of Experimental Psychology*, 53 (4), 1143-62. doi: 10.1080/713755937.

Hayes, S., Hirsch, C.R., Krebs, G., & Mathews, A. (2010). The effects of modifying interpretation bias on worry in generalized anxiety disorder. *Behaviour Research and Therapy*, 48, 171-8. doi: 10.1016/j.brat.2009.

Hirsch, R., C., Krahé, C., Whyte, J., Loizou, S., Bridge, L., Norton, S., & Mathews, A. (submitted). Interpretation training to target repetitive negative thinking in Generalized Anxiety Disorder and Depression, *Journal of Consulting and Clinical Psychology*.

Hirsch, C. R., Clark, D. M., & Mathews, A. (2006). Imagery and interpretations in social phobia: Support for the combined cognitive biases hypothesis. *Behavior Therapy*, *37*(3), 223-236.

Henry, J., & Crawford, J. (2005). The short-form version of the Depression Anxiety Stress Scales (DASS-21): Construct validity and normative data in a large non-clinical sample, *The British Journal of Clinical Psychology*, 44 (Pt 2, 227-39. doi:10.1348/014466505X29657.

Hirsch, C., Hayes, S., & Mathews, A. (2009). Looking on the bright side: accessing benign meanings reduces worry, *Journal of Abnormal Psychology*, 118 (1), 44-54. doi: 10.1037/a0013473.

Hirsch, C. R., Meeten, F., Krahé, C., & Reeder, C. (2016). Resolving ambiguity in emotional disorders: The nature and role of interpretation bias. *Annual Review of Clinical Psychology*, 28, 281-305. doi: 10.1146/annurev-clinpsy-021815-093436.

Holland, J., Hall, N., Yeates, D. G., & Goldacre, M. (2016). Trends in hospital admission rates for anorexia nervosa in Oxford (1968–2011) and England (1990–2011): database studies. *Journal of the Royal Society of Medicine*, *109*(2), 59-66.

Huppert, J.D., Pasupuleti, R.V., Foa, E.B., & Mathews, A. (2007). Interpretation biases in social anxiety: response generation, response selection, and self-appraisals, *Behaviour Research and Therapy*, 45, 1505-15. doi:10.1016/j.brat.2007.01.006

Jansen, A. (2016). Eating disorders need more experimental psychopathology, *Behaviour Research and Therapy*, *86*, 2-10. doi: 10.1016/j.brat.2016.08.004.

Krahé, C., Mathews, A., Whyte, J., & Hirsch, C. R. (2016). Cognitive bias modification for interpretation with and without prior repetitive negative thinking to reduce worry and rumination in generalised anxiety disorder and depression: protocol for a multisession experimental study with an active control condition, *BMJ open*, *6*(12), e013404.

Lovibond, S., & Lovibond, P. (1995). Manual for Depression Anxiety Stress Scales (2nd ed.). Psychology Foundation of Australia: Sydney.

Luce, KH., & Crowther, JH. (1999). The reliability of the Eating Disorder Examination-Self-Report Questionnaire Version (EDE-Q), *The International Journal of Eating Disorders*, 25 (3), 349-51. doi:10.1002/(SICI)1098-108X(199904)25:3<349::AID-EAT15>3.0.CO;2-.

Marks, I. (1986). Behavioural psychotherapy, John Wright: London.

Marzola, E., Fassino, S., Amianto, F., & Abbate-Daga, G. (2017). Affective temperaments in anorexia nervosa: The relevance of depressive and anxious traits. *Journal of Affective Disorders*, *218*, 23-29.

Mathews, A., & Mackintosh, B. (2000). Induced emotional interpretation bias and anxiety, *Journal of Abnormal Psychology*, 109 (4), 602-15. doi: 10.1037/0021-843X.109.4.602.

Mond, JM., Hay, PJ., Rodgers, B., Owen, C., & Beumont, PJV. (2004). Validity of the Eating Disorder Examiniation Questionnaire (EDE-Q) in screening for eating disorders in community samples, *Behavior Research & Therapy*, 42 (5), 551-567. doi: 10.1016/S0005-7967(03)00161-X.

Morris, S., & DeShon, R. (2002). Combining effect size estimates in meta-analysis with repeated measures and independent-groups designs, *Psychological Methods*, 7 (1), 105-125. doi: 10.1037//1082-989X.7.1.105.

Mundt, J., Marks, I., Shear, & Greist, J. (2002). The work and social adjustment scale: a simple measure of impairment in functioning, *The British Journal of Psychiatry*, 180: 461-4.

Rieger, E., Van Buren, D.J., Bishop, M., Tanofsky-Kraff, M., Welch, R., & Wilfley, D. E. (2010). An eating disorder-specific model of interpersonal psychotherapy (IPT-ED): causal pathways and treatment implications. *Clinical Psychology Review*, 30, 400-10. doi: 10.1016/j.cpr.2010.02.001

StataCorp. 2015. Stata Statistical Software: Release 14. College Station, TX: *StataCorp* LP.

Suresh, K. (2011). An overview of randomization techniques: An unbiased assessment of outcome in clinical research, *Journal of Human Reproductive Sciences*, 4 (1), 8-11. doi: 10.4103/0974-1208.82352.

Treasure, J., & Cardi, V. (2017). Anorexia Nervosa, Theory and Treatment: Where Are We 35 Years on from Hilde Bruch's Foundation Lecture? *European Eating Disorders Review*, *25*(3), 139-147.

Treasure, J., Cardi, C., Leppanen, J., & Turton, R. (2015). New treatment approaches for severe and enduring eating disorders, *Physiology & Behavior*, 152, 456-65. doi: 10.1016/j.physbeh.2015.06.007.

Treasure, J., Crane, A., McKnight, R., Buchanan, E., & Wolfe, M. (2011). First do no harm: iatrogenic maintaining factors in anorexia nervosa, *European Eating Disorders Review*, 19 (4), 296-302. doi: 10.1002/erv.1056.

Treasure, J., & Schmidt, U. (2013). The cognitive-interpersonal maintenance model of anorexia nervosa revisited: a summary of the evidence for cognitive, socio-emotional and interpersonal predisposing and perpetuating factors. *Journal of Eating Disorders*, 1:13. doi: 10.1186/2050-2974-1-13

Williams, K. D., Cheung, C. K., & Choi, W. (2000). Cyberostracism: effects of being ignored over the Internet. *Journal of personality and social psychology*, *79*(5), 748.

Zahra, D., Quereshi, A., Henley, W., Taylor, R., Quinn, C., Pooler, J., Hardy, G., Newbold, A., & Byng, R. (2014). The work and social adjustment scale: reliability, sensitivity and value, *International Journal of Psychiatry in Clinical Practice*, 18 (2), 131-8. doi: 10.3109/13651501.2014.894072.

Table 1. This shows the demographic and clinical characteristics for the women with AN**.** Abbreviations: BMI = Body Mass Index; EDEQ = Eating Disorders Examination Questionnaire; DASS = Depression Anxiety Stress Scale; WSAS = Work Social Adjustment Scale; ARS-Q = Adult Rejection Sensitivity-Questionnaire.

	Total sample (N = 55) Mean (SD)	Inpatient women (N = 26) Mean (SD)	Community (N = 29) Mean (SD)	Test statistic Significance
Age	28.5 (10.7)	25.2 (8.5)	31.48 (11.8)	t = -2.29, p = .026
Years of education	16.5 (2.8)	15.7 (2.3)	17.1 (3)	t = -1.84, p = .07
BMI	15.4 (1.6)	15.1 (1.15)	15.8 (2)	t = -1.55, p = .129
Illness duration (years)	10.9 (9.1)	8 (7.8)	13.4 (9)	t = -2.18, p = .034
EDEQ - Restraint	3.2 (1.8)	2.5 (1.77)	3.9 (1.7)	t = -2.97, p = .004
EDEQ - Eating Concern	3.3 (1.6)	2.7 (1.5)	3.7 (1.5)	t = -2.46, p = .017
EDEQ - Weight concern	3.6 (1.6)	3.2 (1.6)	3.9 (1.5)	t = -1.69, p = .097
EDEQ - Shape concern	4.1 (1.4)	3.9 (1.5)	4.3 (1.4)	t = 1.01, p = .316
EDEQ - Total	3.5 (1.5)	3.1 (1.5)	4 (1.43)	t = -2.23, p = .03
DASS - Stress	24.1 (10.4)	22.7 (9.9)	25.4 (10.7)	t = -.96, p = .342
DASS - Depression	22.3 (11.4)	20.5 (10.5)	23.9 (12.2)	t = -1.1, p = .28
DASS - Anxiety	15.3 (11)	13.4 (9.2)	17.1 (12.2)	t = -1.26, p = .212
DASS - Total	61.8 (29.2)	56.6 (25.2)	66.4 (32)	t = -1.25, p = .217
WSAS	24.6 (9)	24.8 (8.2)	24.4 (9.7)	t = .175, p = .86
ARS-Q	14.9 (6.6)	13.8 (7)	15.8 (6.3)	t = -1.12, p = .267

Table 2. This shows the mean frequency of participant's negative and benign 'best' responses on the sentence completion task pre and post cognitive bias modification training. Abbreviations: M = Mean; SD = Standard Deviation; SMC = Standardised Mean Change; CBM-I = Cognitive Bias Modification for Interpretation biases.

		Experimental condition			Control condition		
	Sentence completion task ('Best' completions)	Pre CBM-I M (SD)	Post CBM-I M (SD)	SMC (95% CI)	Pre CBM-I M (SD)	Post CBM-I M (SD)	SMC (95% CI)
Total sample (*N* = 55)	Negative interpretations	5.47 (2.65)	4.05 (2.72)	-.66 (-.37, -.95)	5.73 (2.68)	4.74 (2.59)	-.42 (-.15, -.7)
	Benign interpretations	4.45 (2.62)	5.85 (2.7)	.66 (.37, .95)	4.2 (2.7)	4.94 (2.53)	.3 (.04, .59)
Inpatient women	Negative interpretations	4.69 (2.59)	3.23 (2.64)	-.56 (-.15, -.98)	4.46 (2.5)	4.23 (2.32)	-.09 (-.3, .47)

(*N* = 26)							
	Benign interpretations	5.15 (2.56)	6.65 (2.61)	.58 (.16, 1)	5.42 (2.59)	5.42 (2.37)	.00 (-.38, .38)
	Negative interpretations	6.17 (2.55)	4.79 (2.61)	-.78 (-.37, -1.2)	6.86 (2.33)	5.21 (2.77)	-.85 (-.43, -1.28)
Community women (*N* = 29)							
	Benign interpretations	3.83 (2.55)	5.14 (2.63)	.78 (.36, 1.19)	3.1 (2.33)	4.52 (2.63)	.69 (.28, 1.09)

Study outline

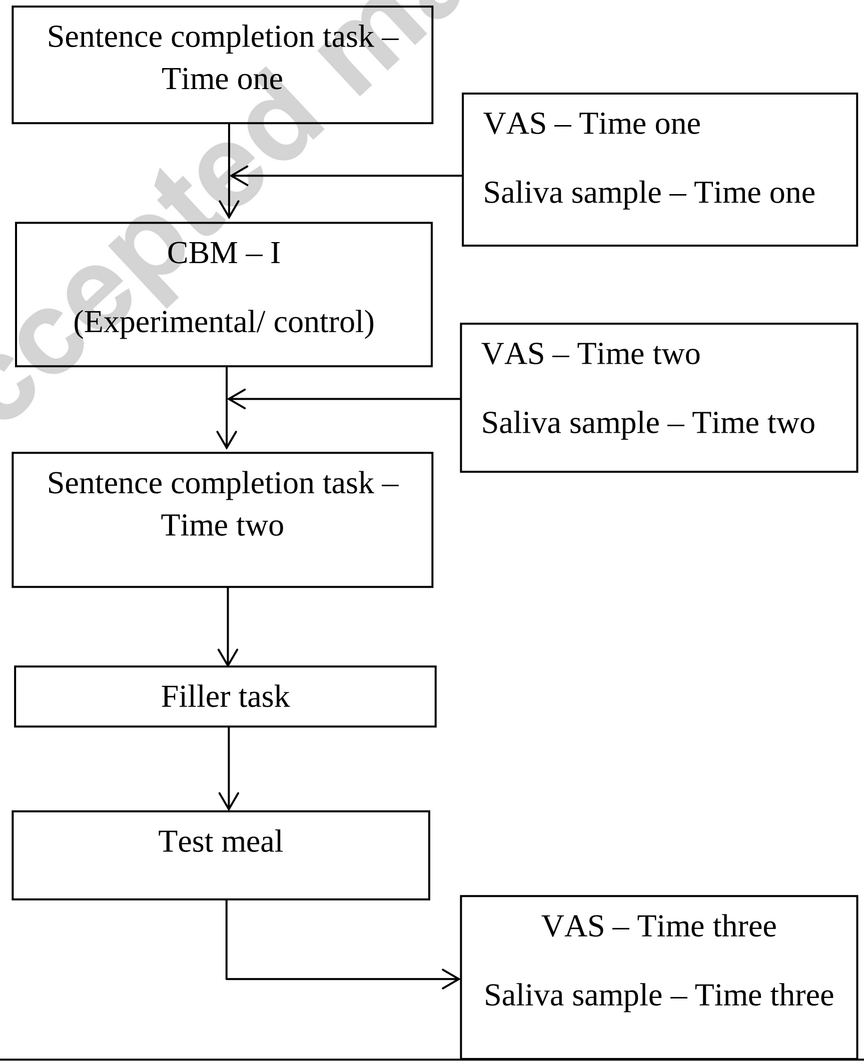


Figure 1. This flow-chart shows an outline of the studies procedure. Abbreviations: CBM-I = Cognitive Bias Modification for Interpretation biases; VAS = Visual Analogue Scale.

Highlights

- A negative interpretation bias for social stimuli might underlie Anorexia Nervosa (AN).
- Women with AN received a single session of Cognitive Bias Modification for Interpretation biases (CBM-I) or a control condition (a 50% dose of training).
- Both training conditions led to a significant reduction in a negative interpretation bias.
- No effect on eating behaviour or stress was found, which may be expected as the training conditions did not significantly differ in interpretation bias change.
- Multi-session training interventions may be required to clarify the effect of CBM-I on AN symptomatology.